## *GUEST EDITORIAL*

# THE FUTURE OF INFORMATION SYSTEMS: LEADERSHIP THROUGH ENTERPRISE INTEGRATION

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*ABSTRACT: The proliferation of computing in organizations is leaving behind a trail of systems which cannot share valuable information that is generated in an organization. With increasing competition and turbulence in the business environment it is vital that there be integration of strategic computing resources in an organization. The future of IS as a field lies in acknowledging this fact and laying the foundation for both research and teaching in the area of enterprise and system integration. In the past we have focused primarily on basic software packages, but with the rapid explosion of connectivity and interoperability of computing in organizations that locus of attention must shift to the more pressing needs of enterprise integration. The incorporation of more work with a focus on the organizational level of analysis would clearly be a step in the right direction and must be regarded as a welcome indication of the maturation of IS.*

*KEYWORDS: Information Systems, Education, Enterprise Integration, Client/Server Computing, Object-oriented*

## INTRODUCTION

Not a single day goes by without the media reminding us of the fact that we are living in an information age, and that the decade of the 90's will be the so-called "information decade." Information technology is omnipresent and is blowing powerful winds of change across all facets of organizational life. It is important to realize that there exist other forces in the environment that are creating fundamental shifts in the way organizations do business today. Over the last decade, we have witnessed changes from small tune-ups in remote parts of the organization to large-scale transformations (strategic, technological, structural and human resources) that span entire organizations. The challenges that stem from a highly competitive global environment, new technologies, and deregulation are all forcing organizations to seek higher levels of performance to reestablish their dominance, regain their market share, and in some cases tc ensure their survival. The challenges of the 90's will be as follows:

1. to integrate information systems into changing organizations to form a cohesive unit capable of delivering quality, innovation and customer satisfaction
2. to tie computing and communication resources into an integrated enterprise
3. to design computing processes, in parallel with organizational processes (co-design) to ensure flexible organizations which can adapt to changes in the business environment.

The rapid proliferation of computing is leaving behind a trail of systems which cannot share information that is produced

in an organization. With increasing competition and upheaval in the business environment it is critical that computing resources in an organization be integrated to ensure competitive advantage. The future of IS as a field lies in endorsing this fact and laying the foundation for both research and teaching in the area of enterprise and system integration. In the past we have focused primarily on basic software packages, but with the rapid explosion of connectivity and interoperability of computing in organizations, that locus of attention must shift to the more pressing needs of enterprise integration. In this paper, we present our views on the directions that IS should adopt in order to establish a dominant role in organizations.

It is important to understand that we use a broad definition of information technology (IT) that includes hardware and software of all types, as well as the increasing integration of computing and communications technologies (local and wide area networks), i.e. connecting two personal computers, or personal computer to servers, or large globe spanning networks of mainframe computers (e.g. Bitnet, Internet).

In the past two decades, technological innovations have come about in small incremental improvements that continuously refine a technology until there is a significant breakthrough that represents a quantum leap. An example of one such technological innovation is computer networking. Initially, in the early 70's, networking was developed so that scarce resources such as printers could be shared more effectively in organizations. In the early 80's with the advent of network operating systems, we entered the bold new world of workgroup computing, where resources (files, printers etc.) could be shared transparently between several users without any implicit knowledge of their location. In the late 80's, the client/server concept represented a breakthrough in network computing and one which could fundamentally change the way computing is perceived in organizations.

One of the pressing problems that had come to the fore with increasing adoption of computing in organizations was the creation of "islands of computing" i.e. systems which were not compatible and hence could not share information with each other. The client/server concept provides a way to integrate systems through effective interprocess communication (IPC's) and create an enterprise wide web of computing.

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To design effective and seamless enterprise integration, some of the existing organizational processes would have to be re-designed. The challenges in the area of enterprise integration are both organizational and technical. The organizational issues are understanding and diagnosing the underlying processes in the organization. Organizational diagnosis is concerned with assessing how the work is currently being performed and identifying gaps between actual and desired work dynamics and also identifying areas where the current organization design is working against the achievement of the valued outcomes. It involves collecting pertinent information, analyzing it, and drawing conclusions about how to design for improved performance. It provides a baseline of data against which to assess the impact of a new design. The critical elements of this process are: What and how should the information about the work be collected? How should the information be assembled to create a coherent workflow that resembles actual practice? How can we identify deficiencies in workflows? What are the metrics on which the redesign process is based upon? The organizational issues are critical to the success of any enterprise integration effort as according to the old adage, "understanding the problem is half the solution."

The technical challenges are listed below:

1. Developing a new genre of computational tools to help in organizational diagnosis, representation and re-engineering of workflows.
2. Software development using the object-oriented, message passing and event-driven paradigm.
3. Installing different types of networks and ensuring interconnectivity and interoperability.
4. Building generic, reusable, configurable software component toolkits. These toolkits will be subject specific (accounting, manufacturing, engineering, education and entertainment) , and provide the ability to shield the application developer from the complexity of underlying details thereby improving productivity, quality, and reliability.

The sections that follow will present the relationship between IT and organizational processes, IT and IS education, introduce system and enterprise integration in greater detail and present its implications on both research and pedagogy in the information systems field. In order to draw implications from the proposed framework, it is useful to reason from a set of propositions that define the foundations for the future of information systems.

## INTEGRATING IT INTO ORGANIZATIONS

It is important to juxtapose and integrate technological progress with rapid and turbulent changes in organizational needs. We must not polarize ourselves into factions such as theoretical vs. practical (or behavioral vs. technical) orientations but must understand the integration of the two to solve real world business problems.

Users and organizations don't buy technologies but rather potential solutions to existing business problems. Hence, it is important to understand how a technology enables the solution of an organization's problems. For example, on June 22, 1990, a team of engineers from Northrop and McDonnell Douglas rolled out the prototype of the YF-23 Advanced Tactical Fighter, the result of state-of-the-art aircraft design and manufacturing technologies. This event was made possible by use of enterprise networking linking the two collaborating partners, their suppliers and their customer - the U.S. Air Force.

The success of this project hinged on changing the existing organizational processes to support distributed collaborative work across organizational boundaries and cutting across functional barriers to promote concurrency in design, manufacturing and analysis. This was essential in cutting the time from initial concept to production release and represents a transition from the sequential way of doing work to a more concurrent way of doing work. Figure 1 illustrates the relationship between IT and organizational work processes and raises three important questions in Table 1 :

Organizations consist of the following elements: work, structure, processes, people, rewards, decision-making and information. Design is the process whereby the designer balances organizational elements to achieve results. It is a daunting task to adequately balance the IT design elements with the organizational design elements to create efficient processes. The future of IS lies in untangling this intricate web and finding solutions for organizational problems.

## IT AND IS EDUCATION

The changing technology and organizational environment brings to the fore the pressing issue facing us, today, in academia, how to train the next generation of students to be successful in the 90's. The graduates of our academic programs represent the future of our profession. Their education and training must prepare them for timely, long-lasting and value-laden

**Table 1: THREE IMPORTANT QUESTIONS TO THE RELATIONSHIP BETWEEN (IT) AND ORGANIZATIONAL WORK PROCESSES**

1. How can IT support existing organizational work (work centered approach)?
2. How can existing processes be transformed using IT (IT centered approach)?
3. How can IT and organizational processes be designed simultaneously to complement each other (co-design)?

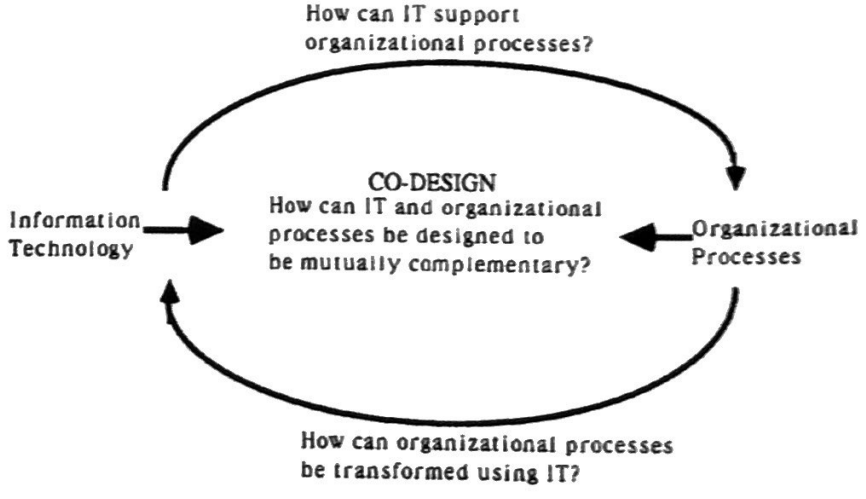
contribution to all types of organizations. IS curriculum must change and focus on leadership. To achieve this, we have to be bold and aggressive in taking steps that may be viewed with skepticism by other departments or faculty members.

As educators, we are in the unique position of focusing students' minds to fit the organizational needs. In IS, this process is more difficult than in other functional areas, e.g. accounting, marketing or finance, as technological progress is constantly changing organizational needs.

We are placed in the unenviable position of constantly aiming at a moving target. This also places a tremendous burden on the faculty as they unlearn old techniques and learn new techniques which are not construed as fads to be relegated to "jargon jail". Some of the technologies have huge learning curves and this often creates faculty inertia. Inertia is very often reflected in the quality of the curriculum and relevance to the industry.

The locus of IS teaching has primarily revolved around teaching individuals software packages (e.g. word processing, spreadsheet analysis, database management systems, presentation graphics etc.) for performing basic knowledge work. While in the past, due to the complexity of using these software packages, it was deemed important to teach these basic skills to the IS student, this focus is no longer tenable with the increasing user-friendliness of the graphical user interface and the average level of computer literacy one can expect from an IS student. Teaching software packages tends to smother the underlying concepts in the quagmire of trivial detail.

**Figure 1: RELATIONSHIP BETWEEN IT AND ORGANIZATIONAL PROCESSES**



Emphasis must be placed on concepts rather than rote memorization of commands. Also, teaching the basic software toolkit of applications is often made moot by technological advances.

In the next section we show how organizational issues and technology issues can be integrated under one framework to aid in providing a coherent view of computing.

## THE VISION - ENTERPRISE INTEGRATION FRAMEWORK

Enterprise integration (EI) refers to the integration of data, organizational communications (between different levels of analysis - individuals, groups or organizations) and business processes across parochial boundaries, such as functions or product lines, to aid in promoting organizational goals. Organizational goals could be reducing time to market, improving service and quality, reducing risk and cost and increased market share. To some, such desiderata may suggest shared goals among organizational participants. Such a view may or may not be true depending on the lens with which the process is viewed.

For example, in the case of intra-functional integration, the goals of the different functional units in manufacturing, such as materials and production may contradict each other, as materials would like to have the least inventory possible and production would like to have a large safety or bonepile stock. However, when viewed in terms of the continuous production process with Just-In-Time inventory their goals converge.

## DIMENSIONS OF THE "ENTERPRISE INTEGRATION" CONSTRUCT

In this section we will elaborate on the multi-dimensional construct of enterprise integration (EI) and will define propositions which lay the foundations for enterprise integration. We will also discuss key technologies, which should not be treated like "silver bullets" but which seem to hold the most promise in enabling the proposition.

The definition of EI presented in the previous section is relatively general, but can be focused by viewing EI as a multi-dimensional construct. The construct can be operationalized along two major dimensions. One, according to the level of analysis, Figure 2, (individual, intra-workgroup, intra-functional, inter-functional and inter-enterprise), and two, according to the goals of integration. Level of analysis in a computing environment refers to scale of computing from individual workstations to minicomputers to mainframes. It also refers to the scale of connectivity from standalone PC's, Local Area Networks (LAN), Metropolitan Area Networks (MAN) to Wide Area Networks (WAN). Typically, the goals of integration are to improve the effectiveness of organizations by improving the following indicators : outcomes, processes or procedures.

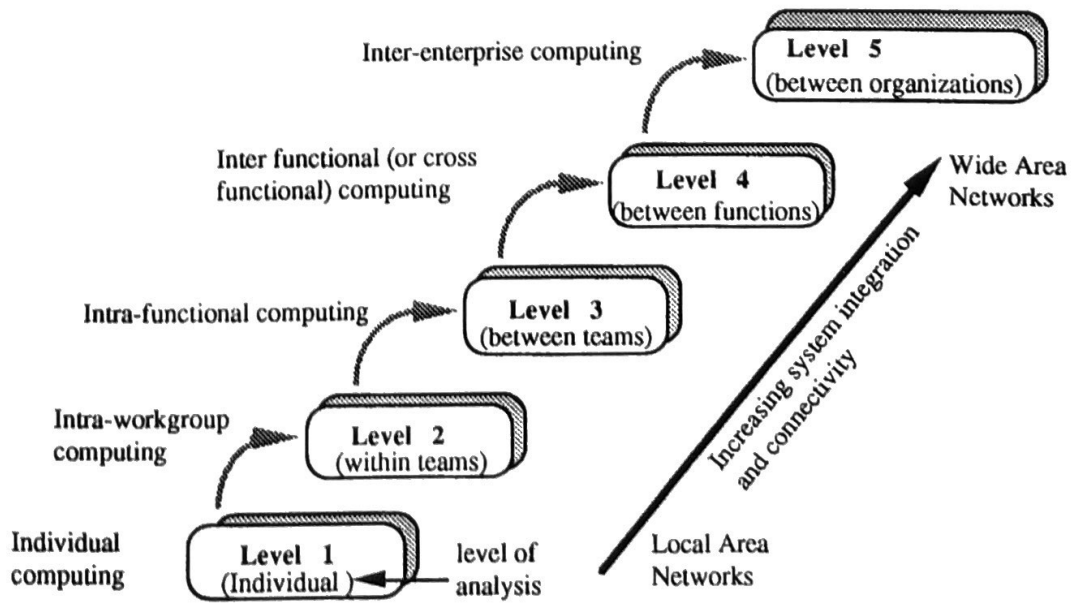
The five major types of computing and integration approaches that organizations adopt according to the level of analysis (Figure 2) are:

### Individual computing

Proposition 1: At the individual computing level, the focus will be on applications and enabling applications to share information in a transparent manner.

Instead of emphasizing separate software applications to get the job done as had been done in the past, integration at the individual level concentrates on the task, such as producing an annual report, and orchestrating transparent access to and cooperation among separate applications

**Figure 2: FIVE LEVELS OF ENTERPRISE INTEGRATION**



(eg. a spreadsheet linked to a database linked to e-mail).

One technology which shows great promise in this area is the Document-Oriented Interface (DOI ) built on the underlying technological base of inter-application connectivity (IAC). Built on an object-oriented foundation, DOI makes documents, not applications, the focus of personal computing and represents a powerful and intuitive way of viewing the interaction between users and computers.

While there are no technological barriers to DOI, there are a vast number of practical issues that have to be resolved, such as protocols, object standardization and interoperability. The computing required to support message passing, dynamic links and data conversion between object types will consume considerable processing power and may require high performance computers. Another direction of integration is the creation of proactive software which performs tasks through agents and triggers, which is different from the current generation of reactive software.

**Figure 3: INTRA-FUNCTIONAL INTEGRATION**

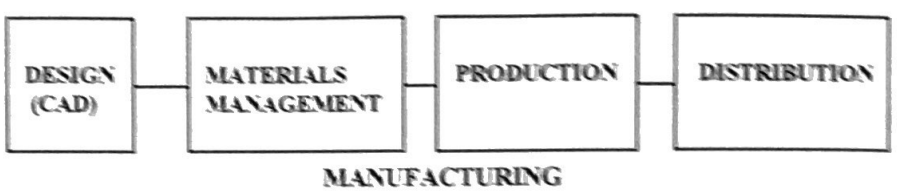



**Figure 4: INTER-FUNCTIONAL INTEGRATION**

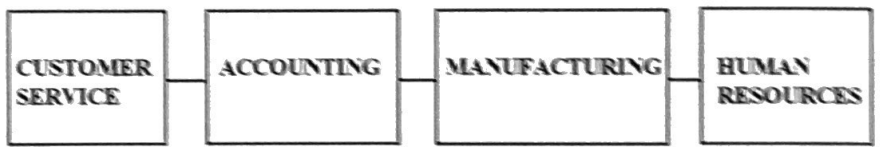
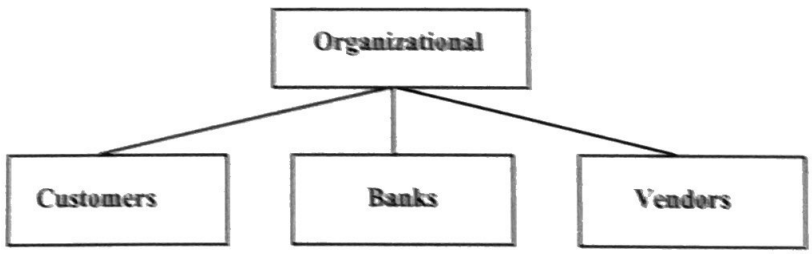



**Figure 5: INTER-ENTERPRISE INTEGRATION**




## Intra-workgroup integration

Proposition 2: At the intra-workgroup level, the focus of integration will be on sharing data and resources within the group. As the size of the group increases, coordination of activities becomes important.

Intra-workgroup integration has the goal of integrating individual users and desktop computers into a network. The genesis of workgroup integration began in the early 80's as isolated data and services in standalone individual computing made it difficult to share data among users in a secure environment. As the number of computers increased in the group, the need to integrate the information became more acute. Workgroup computing allows users to share resources by moving them from the desktop to network servers, operating under a network operating system, allowing users transparent access to shared data and resources, while security and management services, based on the server, ensure data integrity and security. A promising technology in this area is groupware or "workgroup computing" which often includes tools such as electronic mail, conferencing, bulletin boards, calendars, document storage and retrieval.

## Intra-functional integration

Proposition 3: At the intra-functional level, the focus will be system integration of various departments within one functional area enabling the sharing of data to solve business problems. Computing support for the coordination of workflows (e.g. work flow used to deal with materials shortage) will be the key focus of integration.

The single-vendor, highly centralized nature of workgroup computing is not sufficient to meet the needs of intra-functional integration. While workgroup computing began with the goal of integrating desktop computers into a network, intra-functional computing strives to integrate a diverse set of elements on a broader scope. The goal is to provide seamless connectivity in a multivendor environment with a flexible architecture enabling the support of processes in that functional area. For example, in the manufacturing function, production, materials and distribution may have their own separate computing systems based on different vendor architectures. The goal of integration, here, is to allow the seamless sharing of information across these different architectures, so that production will have access to materials information for scheduling orders, and materials will have access to production information for demand forecasting. The technology

required will be a multi-tiered architecture based on client/server computing. The integration of different workgroup systems based on minicomputer and mainframe architectures allows users to preserve their investment in such legacy systems while making better use of competitive information previously not accessible across workgroup boundaries. Client/server computing is not a technology but a methodology which incorporates other leading technologies, such as network operating systems, SQL database software and distributed office-automation solutions.

**Inter-functional integration:**

Proposition 4: At the inter-functional level, the focus will be system integration of various functional areas (e.g. accounting, marketing etc.) enabling the sharing of data to achieve organizational goals (such as increased efficiency, responsiveness to changes in the environment, customer satisfaction etc.). Computing support for the coordination of workflows across functional boundaries (e.g. customer complaint) will be the key focus of integration.

In this age of distributed organizations, intra-enterprise integration involves the integration of LAN's with WAN's to provide businesswide connectivity in a multivendor environment. WAN's allow remote systems to be tied into the network, granting the same transparent access to resources as provided by LAN's. But building a heterogeneous network is only a partial solution to integration. The key is applications, referred to as distributed applications. These applications require program-to-program communication and interaction across the boundaries of machine type, network and workstation operating system platforms.

**Inter-enterprise integration**

Proposition 5: At the inter-enterprise level, the focus will be system integration of various interacting organizations (e.g. suppliers, subcontractors, etc.) enabling the sharing of data to achieve certain organizational goals and the exchanging of services. Computing support for the coordination of workflows across organizational boundaries (e.g. Electronic Data Interchange) will be the key focus of integration.

The goal of inter-enterprise integration is to improve the performance of distributed organizations and markets. It focuses on the communication of information and the coordination and optimization of enterprise decisions and processes in order to achieve higher levels of productivity, flexibility and quality. One of the key issues is that the enterprises must be able to understand each other and this is called "semantic unification." Inter-enterprise integration is based on WAN's connecting the different architectures of the cooperating enterprises. Federated architectures that create the illusion of a shared knowledge base by routing information and requests to the internal knowledge bases of appropriate servers look promising as an enabling technology.

***The goal of inter-enterprise integration is to improve the performance of distributed organizations and markets.***

## DIMENSIONS OF INTEGRATION

Here, we elaborate on what it means to be "integrated". The goals of integration are often the indicators by which the effectiveness of computing in organizations can be judged. Unless the goals are clear, enterprise integration will flounder. In the previous section, we outlined a variety of perspectives on the different levels at which computing can take place in an organization. The goals of integration can be classified into three major categories: Product or outcome oriented, Process oriented, and Procedure or structure oriented.

Product oriented integration is the unification of the organization around the product being delivered. The enterprise management paradigm uses product data models as the basis for enterprise activity and adds process and procedural information as supporting information. The approach is often associated with collaboration where the members share information without revealing the details of the internal processes which may have generated the information.

Process oriented integration is the unification of the organization around the workflows that are used to create the product. The focus is on the quantity and quality of activities carried on by the organization and typically assess effort rather than effect. The Total Quality Management paradigm places a premium on measuring process information and emphasizes process optimization with a view that optimum processes generate sound products.

Procedure oriented integration is the unification of the organization around certain key business rules encapsulating the goals and techniques to optimize the organization's mission, which may emphasize customer satisfaction, quality or some other criteria. Compared to the other two, this is a more dynamic paradigm and stresses flexibility and responsiveness to environmental changes. It is also the most difficult form of integration to achieve in a computing environment as the amount, type and quality of information that must be moved around is often unclear and difficult to assess.

## MEASUREMENT AND METRICS

One research area that is common to all the levels of integration is metrics and methodology. As things stand today, we have no way of measuring the effectiveness of a particular approach on the enterprise. We still have to develop methodologies which allow the design of organizational processes in tandem with the technological processes. Understanding the business requirements, critical success factors and strategic goals is the key at all levels of integration. What are organizational problems and what are their characteristics? How does technology impact the problem

characteristics? Training IS professionals to ask the right questions and eliciting the key information should be a future direction. Only with an understanding of cultural issues, business processes and technology can enterprise integration produce tangible results.

The basic question underlying the set of propositions is how to design various levels of enterprise integration as open systems where people, business processes, organizational goals and hardware/ software components are designed simultaneously. Academically, this translates into an attempt to create a practical theory of sociotechnical systems which involves understanding the fit between technology, people, organization and environment for satisfying the organization needs and goals, and the factors that influence the achievement of this fit.

## IMPLICATIONS FOR IS EDUCATION

Recognizing the direction of change in technology and the movement towards EI raises the question of the IS role. Clearly, IS cannot and should not train students to be just proficient at the technical aspects of network computing. The role of IS teaching and research is to understand the organizational issues, and pioneer the concepts of co-design. IS must deal with the business issues, such as what are the corporate goals and how do they translate into a broad technological design. IS must integrate the concepts from finance, marketing and sales, management science, etc., to solve business problems which often require cross-functional business knowledge. Once the blueprint for the solution of the business problem is laid out, the technological infrastructure is built by individuals trained in computer science and electrical engineering.

## SUMMARY

The proliferation of computing in organizations is leaving behind a trail of systems which cannot share valuable information that is generated in an organization. With increasing competition and turbulence in the business environment it is vital that there be integration of strategic computing resources in an organization. The future of IS as a field lies in acknowledging this fact and laying the foundation for both research and teaching in the area of enterprise and system integration. In the past we have focused primarily on basic software packages, but with the rapid explosion of connectivity and interoperabiltiy of computing in organizations that locus of attention must shift to the more pressing needs of enterprise integration.

Effective enterprise integration faces organizational and technical challenges. The organizational issues are : understanding and discovering the underlying processes in the organization. This would involve skills such as data gathering and data analysis. Other issues involve discovering processes which can be made more effective according to some criteria. The technical issues are : installing networks, connectivity, interoperability, scalability, software development and educating the users.

While it is always imprudent to be overly sanguine about recent developments in the arena of computing, it does seem to us that the past decade of technological innovations and improvements do provide evidence of significant progress in the direction of enterprise integration. The alarming factor is the lack of realization and understanding of this among IS departments about its impact on organizations in the near future. From our early days, our teaching emphasis has solely been to train students in software packages without providing the broader inspirational vision of how all the pieces of the puzzle fit together to solve the business needs of organizations. We have attempted in this paper to articulate one such vision based on enterprise integration and hasten to add that this is only one way of viewing the organizational world. The incorporation of more work with a focus on the organizational level of analysis would clearly be a step in the right direction and must be regarded as a welcome indication of the maturation of IS.

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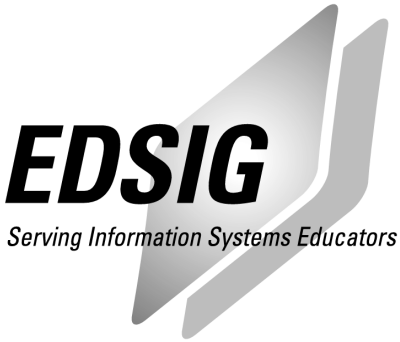


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